those along its banks and on the islands in the stream. Even crows, unable to survive the cold, can be seen everywhere clinging frozen to the bare trees.—*Brooklyn Daily Eagle, February 17, 1922.*

Italy.—ROME, February 9.—The cold wave which is the severest in years, accompanied by a considerable fall of snow, has forced a modification of the coronation ceremonies for Pope Pius XI, Sunday.—*New York Evening Mail, February 9, 1922.*

Samoa.—APIA, February 3.—The steamer *Suva* arrived at Suva after encountering a cyclonic storm early on Saturday.—*Samoa Times.*

DETAILS OF THE WEATHER IN THE UNITED STATES.

GENERAL CONDITIONS.

By A. J. HENRY.

Among the larger features of the month was the pronounced increase in the number and intensity of cyclonic storms which passed inland from the Pacific south of the mouth of the Columbia River. This movement in latitude was directly responsible for the increase in precipitation in California and perhaps in the Gulf and South Atlantic States. The mean temperature in Montana, the Dakotas, Wyoming, and Idaho was much below the seasonal normal, especially in Montana. East of the Mississippi, however, except for Wisconsin and a part of Minnesota, mean temperature was uniformly in excess of normal. The single event which stands out prominently in the month's weather was the fall of snow in the Plains States and the intense glaze storm in Wisconsin and Michigan during the last week of February.

CYCLONES AND ANTICYCLONES.

By W. P. DAY, Observer.

Low-pressure areas were mostly of Pacific origin and their tracks covered a wide range in latitude. The high-pressure areas, however, which were mostly of the Alberta type, came in rapid succession and generally confined themselves to a well-marked path. The number of HIGHS plotted was considerably above the normal.

Tables showing the number of HIGHS and LOWS by types follow:

Lows.	Alberta.	North Pacific.	South Pacific.	Northern Rocky Mountain.	Colorado.	Texas.	East Gulf.	South Atlantic.	Central.	Total.
February, 1922...	2.0	6.0	2.0	.....	1.0	3.0	.....	2.0	.....	16.0
Average number 1892–1912, inclusive.....	3.1	2.3	1.0	0.2	1.5	1.5	0.5	0.2	0.7	11.0

Highs.	North Pacific.	South Pacific.	Alberta.	Plateau and Rocky Mountain region.	Hudson Bay.	Total.
February, 1922.....	1.0	2.0	9.0	1.0	1.0	14.0
Average number, 1892–1912, inclusive.....	0.8	0.5	4.7	1.2	0.6	7.8

FREE-AIR CONDITIONS.

By W. R. GREGG, Meteorologist.

For the month as a whole free-air temperatures were below normal in the Northern States and above normal in the Southern States, thus conforming quite closely to mean values at the surface. The largest negative departures occurred at Ellendale, being most pronounced in the lower levels and becoming rather steady at about −2.5° C. above 1,500 meters. A similar though smaller decrease in departures in the upper levels was observed also at Drexel and Royal Center. The same tendency is apparent in the values at Broken Arrow and Groesbeck, where temperatures were above normal at all levels, but increasingly so as greater altitudes were reached. In other words, owing to some widespread influence, the temperature decrease with altitude in all parts of the country was considerably less than normal, and hence the upper levels were warm as compared with those near the surface. Indeed, at Ellendale, where there is normally in February a practically isothermal condition from the surface to 2,000 meters above sea level, there was during the present month a large inversion, the recovery of temperature not taking place until an altitude of 3,000 meters was reached. At all stations conditions were more nearly like those usually found in December and January than those found in February. The cause is not far to seek. A glance at Chart IV will show that there was a larger latitudinal temperature gradient than normally occurs—a condition that would produce relatively low free-air pressures in the North and relatively high in the South, with a resulting larger south component or (what amounts to the same thing) a smaller north component in the winds. That this is what actually occurred is indicated by the values given in Table 2. The departures from normal were small, but in nearly all cases they were in the same direction, sufficiently so to cause the temperature anomalies referred to.

In general the changes in free-air temperature from day to day were in the same sense as were those at the surface. There were some exceptions, however, mostly associated with anticyclones in the northwest. These areas of high pressure are usually accompanied by clear weather, and radiation is very active. Not infrequently, as the center passes a given point and the wind shifts from northerly to southerly, the surface temperature remains low or even continues to fall. This tendency exists only in the lowest layers, usually within 200 to 500 meters of the surface. At higher levels the response of temperature to the wind shift is immediate and decided. A case in point occurred on February 19 to 20, during which period a moderate anticyclone moved almost due east from eastern Montana to Minnesota. Generally clear weather prevailed. At both Ellendale and Drexel the wind at all levels was NW. and fairly strong, and temperatures were low as the anticyclone approached. When the crest of the latter passed these stations the wind became SE. to SW. and of moderate strength, and the temperature in the free air therefore increased, but that at the surface continued to fall. The rise in temperature at the upper levels was not large, the wind changing only from NW. and WNW. to WSW. When the wind shifts through a larger angle the changes in temperature likewise become greater. For example, from February 6 to 7 the free-air wind backed from N. and NNW. to SW., the temperature meanwhile increasing about 15° C. This is the type of change that occurs above the surface, even though the reverse change occurs for a time at the latter, owing to radiation or to peculiar local effects of topography, etc. In this connection it is of interest to recall that the temperature distribution in winter cyclones in the extreme Northwest—near the Pacific—is usually quite the reverse

of that found in these cyclones after they have reached the central and eastern States, i. e., NW. winds from the Pacific are warm and SE. winds from the continent are cold. Unfortunately no free-air observations have yet been made in this region, and it is therefore impossible to say what the temperature distribution above the surface is. However, it seems reasonable to assume that in front of the cyclone there is an inversion and behind it a lapse rate not greatly differing from normal, with the result that at some moderate height the temperature is higher in the southerly than in the northerly current. This assumption finds support in the case above cited, viz, that of February 19 to 20, when the southerly current in the rear of the anticyclone was cold at the surface but warm at higher levels.

The lowest free-air temperatures recorded during the month were −27° C. at an altitude of 4,500 meters at Drexel on the 5th and −28° C. at an altitude of 4,000 meters at Ellendale on the 27th.

Relative humidity was slightly above normal in the extreme North and South, and below at intermediate stations. The departures from normal were of about equal amount at all levels, except at Groesbeck, where there was an increasing plus departure with height. Vapor pressure at this station was also decidedly above normal. Elsewhere there was for the most part a moderate minus departure.

As already stated, resultant winds were from a more southerly point than usual. There was a fairly large plus departure in wind speeds at Groesbeck and Royal Center, but elsewhere little variation from the normal.

Unusually high winds were observed as follows:

[By means of kites.]

Station.	Date.	Direction.	Velocity.	Altitude.
			m. p. s.	*Meters.*
Due West, S. C.	3	w.	37	2,100
Groesbeck, Tex.	9	wsw.	38	1,400
Royal Center, Ind.	8	sw.	45	900
Do.	11	w.	35	3,800

[By means of pilot balloons.]

Bolling Field, D. C.	3	w.	38	2,700
Broken Arrow, Okla.	2	w.	46	3,900
Do.	3	w.	50	5,700
Burlington, Vt.	21	w.	38	4,000
Do.	25	w.	35	5,000
Drexel, Nebr.	13	wnw.	38	5,100
Due West, S. C.	2	w.	47	4,400
Do.	3	w.	35	3,100
Do.	3	wsw.	45	3,500
Do.	4	w.	34	4,400
Ellendale, N. Dak.	6	nnw.	36	6,000
Do.	15	nw.	41	4,200
Do.	16	nw.	35	5,800
Do.	20	w.	35	6,400
Do.	23	w.	44	7,700
Groesbeck, Tex.	6	wsw.	35	3,000
Lansing, Mich.	17	wsw.	39	2,200
Madison, Wis.	7	nnw.	38	4,200
McCook Field, Ohio.	13	w.	39	4,100
Do.	14	wsw.	41	5,000
Do.	24	w.	34	4,200
Mitchell Field, N. Y.	8	nw.	42	2,700
Do.	24	nw.	66?	3,500
Royal Center, Ind.	11	w.	40	5,800
Do.	14	w.	38	5,200
San Francisco, Calif.	11	wnw.	36	4,100
Washington, D. C.	2	wsw.	39	3,200
Do.	3	w.	44	2,700
Do.	14	w.	34	5,000
Do.	25	w.	39	2,400

Free-air winds at altitudes of 2,000 meters or more were for the most part from a westerly direction. There were no exceptions in the northeastern part of the country as far south as North Carolina and as far west as Indiana. In the Southeastern States easterly winds were general up to 3 or 4 kilometers on the 21st when high pressure prevailed over the lower Lakes and a vigorous cyclone was advancing from the Southern Plains States. These easterly winds were, however, exceedingly light and veered to SSW. with the eastward movement of the cyclone. In southern Florida easterly winds prevailed from the 18th to 24th, but extended only to 3 or 4 kilometers.

A very exceptional case of free-air easterly winds occurred at Ellendale, N. Dak., on the morning of the 28th. The wind at the surface was SW.; from 250 to 2,000 meters it was NW.; and *above* 2,000 meters an easterly wind prevailed up to 5,000 meters, the highest point reached. The afternoon observation showed a similar condition, with some slight changes. A SW. wind still prevailed at the surface; above it in succession were found WNW. winds up to 1,500 meters; SE. from 2,000 to 4,000 meters; and SW. from 4,500 to 7,000 meters. In all cases the winds were light, the lowest velocity, 1 meter per second, being observed in a layer about 1 kilometer thick where the change from a westerly to an easterly component in the winds occurred, and the highest, 8 meters per second, just above the layer of SE. winds in the afternoon.

TABLE 1.—*Free-air temperatures, relative humidities, and vapor pressures during February, 1922.*

TEMPERATURE (°C.).

Altitude. M. S. L. (*m.*)	Broken Arrow, Okla. (233*m.*)		Drexel, Nebr. (396*m.*)		Due West, S. C. (217*m.*)		Ellendale, N. Dak. (444*m.*)		Groesbeck, Tex. (141*m.*)		Royal Center, Ind. (225*m.*)	
	Mean.	Departure from normal.	Mean.	Departure from normal.	Mean.	Departure from normal.	Mean.	Departure from normal.	Mean.	Departure from normal.	Mean.	Departure from normal.
Surface	5.6	+0.2	−5.9	−2.1	10.7		−16.6	−7.7	11.7	+1.9	−1.7	−0.5
250	5.5	+.2			10.5				11.2	+1.8	−1.9	−.5
500	4.3	+.6	−6.5	−2.3	9.2		−16.3	−7.2	10.0	+1.7	−3.6	−.4
750	3.3	+.7	−7.4	−2.9	8.2		−14.6	−5.8	10.0	+2.2	−4.1	
1,000	3.2	+1.1	−6.5	−2.6	7.4		−12.9	−4.3	9.9	+2.4	−4.8	−.3
1,250	3.5	+1.8	−5.0	−1.6	6.4		−11.8	−3.7	9.4	+2.5	−5.7	−.7
1,500	3.0	+2.1	−4.5	−.9	5.5		−11.2	−3.2	8.8	+2.6	−6.2	−.7
2,000	2.1	+2.7	−5.7	−1.1	3.7		−12.0	−2.7	7.0	+2.8	−7.2	−.5
2,500	.0	+3.1	−7.7	−.9	1.2		−13.6	−2.2	5.5	+3.8	−8.0	+.4
3,000	−2.8	+2.8	−10.2	−.7	−.9		−16.4	−2.5	3.3	+4.1	−10.4	+.2
3,500	−5.8	+2.4	−13.0	−.8	−2.1		−18.9	−2.2	.3	+2.9	−13.2	+.1
4,000	−8.9		−15.8	−.3			−21.5	−2.3	−2.6	+2.6	−16.3	−.4
4,500			−18.5	+.2								

RELATIVE HUMIDITY (%).

Surface	63	−6	74	−4	75		87	+8	75	+1	73	−4
250	63	−5			75				73	+1	73	−4
500	63	−4	73	−3	72		85	+7	70	+1	72	−5
750	60	−4	71	−1	70		77	+3	66	+1	70	−4
1,000	56	−2	65	−2	69		72	+1	61	+1	66	−4
1,250	52	−2	60	−3	68		69	+2	58	+2	62	−4
1,500	50	−2	56	−3	66		67	+4	56	+5	58	−4
2,000	44	−8	51	−3	61		66	+5	51	+5	52	−4
2,500	42	−11	50	−2	64		66	+5	47	+5	51	−3
3,000	40	−9	51	−2	58		65	+5	47	+8	53	−1
3,500	38	−9	53	0	54		66	+7	49	+16	54	−1
4,000	36		50	−1			64	+5	50	+22	53	−1
4,500			47	−5								

VAPOR PRESSURE (*mb.*).

Surface	6.18	−0.21	3.01	−0.90	10.34		1.45	−1.29	11.13	+1.90	4.14	−0.43
250	6.14	−.20			10.20				10.57	+1.79	4.08	−.42
500	5.66	+.10	2.83	−.89	9.17		1.44	−1.27	9.39	+1.55	3.64	−.30
750	5.00	+.13	2.54	−.82	8.65		1.48	−1.07	8.57	+1.43	3.25	−.32
1,000	4.50	+.23	2.51	−.64	8.13		1.63	−.81	7.60	+1.23	2.97	−.34
1,250	4.11	+.32	2.50	−.47	7.39		1.78	−.54	6.95	+1.30	2.53	−.46
1,500	3.75	+.36	2.41	−.31	6.82		1.78	−.39	6.43	+1.65	2.19	−.48
2,000	2.91	+.03	2.05	−.20	5.29		1.61	−.24	5.20	+1.61	1.71	−.46
2,500	2.44	−.08	1.75	−.09	4.52		1.41	−.14	4.43	+1.68	1.55	−.26
3,000	2.00	−.08	1.48	−.03	3.50		1.14	−.06	3.94	+1.74	1.25	−.25
3,500	1.53	−.24	1.17	−.03	3.34		.97	+.07	3.49	+1.75	.83	−.39
4,000	1.11		.84	−.06			.90	+.18	3.17	+2.09	.51	−.51
4,500			.61	−.15								

TABLE 2.—*Free-air Resultant Winds (m. p. s.) during February, 1922.*

Altitude. M. S. L. m.	Broken Arrow, Okla. (233m.)				Drexel, Nebr. (396m.)				Due West, S. C. (217m.)		Ellendale, N. Dak. (444m.)				Groesbeck, Tex. (141m.)				Royal Center, Ind. (225m.)			
	Mean.		Normal.		Mean.		Normal.		Mean.		Mean.		Normal.		Mean.		Normal.		Mean.		Normal.	
	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.
Surface	N. 22°E.	1.1	S. 87°W.	0.9	N. 68°W.	2.2	N. 65°W.	1.4	S. 71°W.	1.4	N. 43°W.	5.0	N. 37°W.	2.9	S. 28°W.	1.2	N. 50°W.	0.5	S. 63°W.	2.3	S. 88°W.	2.1
250	N. 24°E.	1.0	S. 69°W.	1.0	.....	.....	.....	.....	S. 78°W.	1.6	.....	.....	.....	.....	S. 24°W.	1.8	N. 68°W.	0.6	S. 68°W.	3.4	S. 83°W.	2.1
500	S. 10°E.	.4	S. 80°W.	1.2	N. 71°W.	3.0	N. 73°W.	2.0	S. 86°W.	3.8	N. 44°W.	5.3	N. 42°W.	3.1	S. 39°W.	2.8	S. 58°W.	1.2	S. 52°W.	4.9	S. 67°W.	3.3
750	S. 5°E.	1.2	S. 62°W.	2.8	N. 80°W.	4.0	N. 71°W.	4.0	S. 85°W.	5.6	N. 47°W.	5.6	N. 50°W.	4.4	S. 36°W.	3.2	S. 58°W.	2.2	S. 65°W.	7.3	S. 64°W.	4.5
1,000	S. 52°W.	1.8	S. 60°W.	4.0	N. 82°W.	5.1	N. 68°W.	5.4	S. 80°W.	7.5	N. 52°W.	6.0	N. 48°W.	5.2	S. 53°W.	4.1	S. 70°W.	3.4	S. 65°W.	9.3	S. 74°W.	5.2
1,250	N. 87°W.	3.0	S. 82°W.	4.5	N. 84°W.	6.9	N. 66°W.	6.6	S. 80°W.	10.2	N. 56°W.	5.9	N. 50°W.	6.4	S. 70°W.	6.9	S. 80°W.	4.3	S. 75°W.	10.1	S. 80°W.	6.9
1,500	N. 86°W.	3.6	S. 87°W.	5.1	N. 78°W.	9.1	N. 67°W.	8.5	S. 76°W.	11.3	N. 62°W.	6.7	N. 58°W.	7.9	S. 74°W.	8.1	S. 88°W.	5.6	S. 81°W.	12.8	S. 81°W.	8.0
2,000	S. 85°W.	6.3	N. 72°W.	7.4	N. 76°W.	11.2	N. 69°W.	10.5	S. 78°W.	14.0	N. 71°W.	9.3	N. 64°W.	9.8	S. 73°W.	11.1	N. 86°W.	7.7	S. 88°W.	15.0	S. 85°W.	9.3
2,500	N. 81°W.	8.1	N. 57°W.	6.1	N. 77°W.	13.2	N. 70°W.	12.4	S. 81°W.	16.1	N. 74°W.	11.4	N. 68°W.	12.4	S. 80°W.	12.0	N. 84°W.	9.2	N. 88°W.	16.8	S. 87°W.	11.7
3,000	S. 88°W.	11.9	N. 77°W.	9.6	N. 84°W.	15.7	N. 73°W.	14.6	S. 84°W.	18.5	N. 83°W.	13.0	N. 70°W.	13.5	S. 79°W.	13.3	W.	11.6	N. 87°W.	20.8	S. 84°W.	12.5
3,500	N. 87°W.	12.4	N. 58°W.	15.0	N. 88°W.	18.2	N. 71°W.	16.0	W.	16.2	N. 78°W.	15.0	N. 72°W.	12.2	S. 54°W.	14.7	N. 82°W.	14.1	N. 84°W.	23.6	S. 89°W.	16.3
4,000	N. 82°W.	9.0	.....	.....	S. 87°W.	18.7	N. 77°W.	15.9	.....	.....	N. 73°W.	14.9	N. 68°W.	12.7	S. 68°W.	20.5	N. 67°W.	12.9	N. 70°W.	23.2	S. 82°W.	17.9
4,500	N. 45°W.	16.5	.....	.....	N. 80°W.	18.0	N. 81°W.	18.5	.....	.....	W.	16.4	N. 64°W.	13.7	.....	.....	N. 77°W.	14.8	N. 67°W.	19.5	.....	.....
5,000	.....	.....	.....	.....	S. 68°W.	18.5	N. 76°W.	19.7	.....	.....	.....	.....	S. 67°W.	18.4	.....	.....	.....	.....	.....	.....	.....	.....

A condition like this one is occasionally, not frequently, observed in summer, when pressure and temperature gradients are weak over extended areas. In this case, however, an anticyclone of great vigor was central a short distance southwest of Ellendale. This position was favorable for the NW. winds that were found in the lower levels. But why the SE. winds above them? Unfortunately only a short kite flight was possible because of light winds. The record showed, however, a marked temperature inversion. On the other hand, there was a fall in temperature with height above Drexel, with the result that, although at the surface the temperature decreased northward, in the free air it decreased southward, thus reversing the normal poleward pressure gradient and consequently producing easterly instead of westerly winds. These easterly winds were general over a considerable portion of the country on this day, but in other places extended down to the surface instead of being underrun by westerly winds. At Drexel, farther removed from the anticyclonic center, ENE. winds were general up to 3,000 meters; above this height there was a sudden shift to WSW.—a direction nearly parallel to the surface isotherms. In this region the poleward temperature gradient was much steeper than it was farther north. NE. winds were observed also at Madison and Broken Arrow up to 2,000 meters; at Camp Lewis, Washington State, up to 4,500 meters; and at San Francisco and Mather Field, Calif., up to 3,000 meters.

THE WEATHER ELEMENTS.

By P. C. DAY, Climatologist and Chief of Division.

PRESSURE AND WINDS.

Changes in atmospheric pressure during the month were frequent but usually not marked, and severe storms or cold waves were mainly of limited extent or duration.

Low areas of the month attended by substantial precipitation and more or less stormy conditions, were confined to a few dates, among which the following stand out most prominently: On the 1st to 3d a storm of wide extent moved from the middle Missouri Valley to the Canadian Maritime Provinces, giving snows over northern districts from the Plateau region to the Great Lakes, and moderate to heavy rains in other portions of the country from the Rocky Mountains eastward. High winds prevailed over the northern plains, reaching blizzard proportions in parts of the Dakotas; on the 14th a storm center developed over the west Gulf and moved rapidly to the northeastward over the Gulf and Atlantic Coast States during the 15th and 16th, giving heavy rains over the central and southern portions of the area, and moderate rains or snows to the northward. On the 21st a low-pressure area moved from the Southwest to the middle plains, and during the following 48 hours extended into the Great Lakes region as a storm of considerable severity. Heavy snows occurred over the regions to northward of the center, heavy rain, snow, and sleet near the center, and rains to the southward. Over the Great Lakes and the northern plains high winds occurred, and in portions of eastern Minnesota, and generally over central Wisconsin and Michigan one of the worst ice storms ever known prevailed. Enormous damage to forests, orchards, and overhead wire systems resulted from the heavy ice coating, and traffic was greatly hindered. A more complete account of this appears on pages 77–82 of this issue.

Stormy conditions prevailed near the close of the month and precipitation was widespread, and in some instances, heavy, over practically all portions of the southern half of the country.

The average pressure for the month was highest over the upper Missouri Valley and the adjacent Canadian Provinces, where it exceeded 30.20 inches, and lowest over the southern portions of the Rocky Mountain and Plateau regions. Compared with the normal it was above in all portions of the United States and the adjacent portions of Canada, save from the central Plateau and Pacific coast regions northward, where it was less than normal.

The principal high winds of the month occurred in connection with the storm of the 21st–23d, particularly during the 23d, over the lower Lakes where maximum velocities of 50 to 80 miles or more per hour were recorded.

The prevailing winds were mainly from the northwest in the Missouri and upper Mississippi Valleys; from southerly points in the Ohio Valley, lower Lakes, and generally over the southeastern States, and variable in other districts.

TEMPERATURE.

The month as a whole was marked by continuous but not severe cold over the upper Missouri Valley, and it was colder than normal over all districts from the Rocky Mountains westward. In portions of Montana and Wyoming the monthly averages were among the lowest of record, the average daily means ranging from 10° to 15° below normal. However, the extreme cold of some other years was not reached.